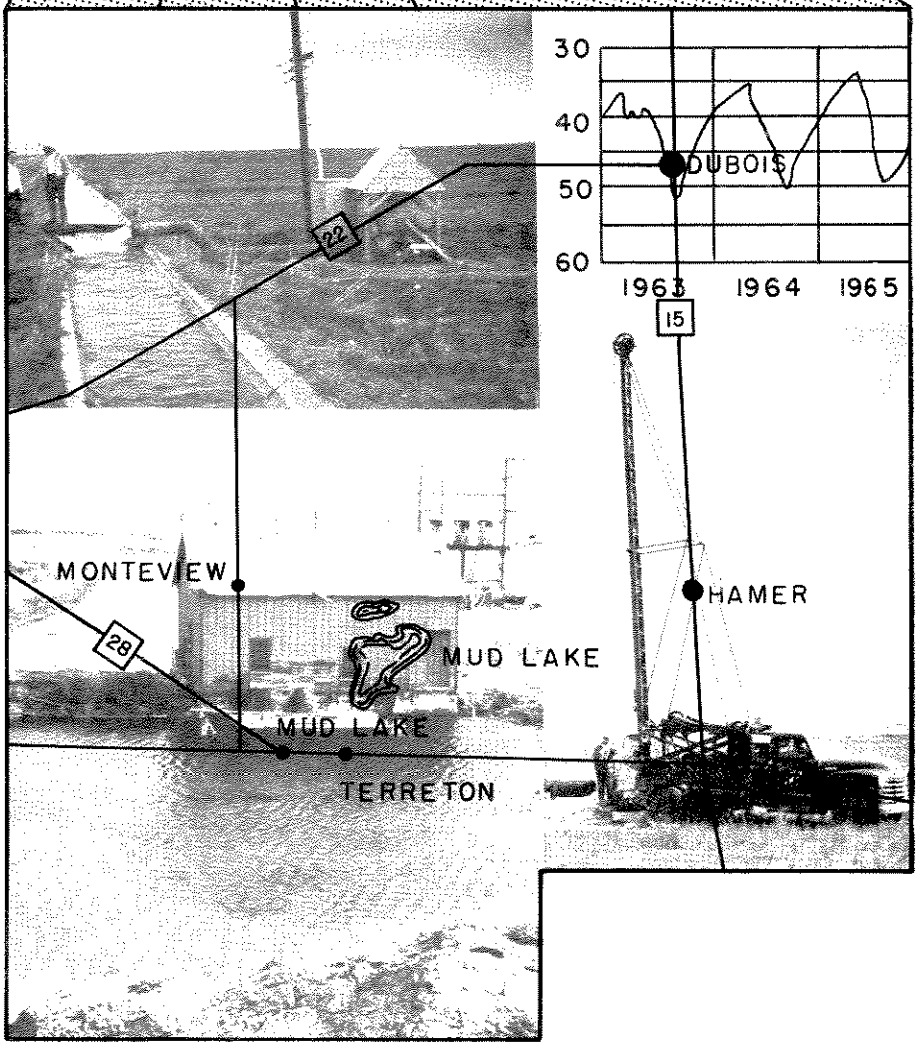
# WATER LEVEL CHANGES IN THE MUD LAKE AREA, IDAHO, 1958-68

Water Information Bulletin No. 7

Idaho Department of Reclamation

January 1969



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# Water-Level Changes in the Mud Lake Area, Idaho, 1958-68

by

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and

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Prepared and Published by

Idaho Department of Reclamation

R. Keith Higginson

State Reclamation Engineer

January 1969

CONTENTS



ILLUSTRATIONS

# INTRODUCTION

## Purpose and Objectives

The Mud Lake area in northeastern Idaho (figure 1) has long been a center of ground-water development. Hundreds of wells have been developed in the area to irrigate many thousands of acres of land. It is important to know the effect of the present well development on the ground-water resource. This information is necessary to allow for maximum development while protecting established water rights. Knowledge of the ground-water resource in the Mud Lake area is also important in understanding the ground-water system underlying the Snake Plain.

Measurements of depth-to-water were obtained in 229 wells in the Mud Lake area in the spring of 1968, ten years after similar measurements were obtained in the spring of 1958. Comparison of the two series of measurements provides information on changes in the ground-water resource as a result of well development. Analysis of the 1968 data provides additional information about the characteristics of the ground-water system and aids in the study of the aquifer underlying the Snake Plain.

## Acknowledgements

The Department of Reclamation and the authors wish to acknowledge the assistance of the Water Resource Division of the U. S. Geological Survey in the preparation of this report. H. G. Sisco, of the Survey, provided valuable aid in analyzing the records and selecting wells to be measured. The U. S. Geological Survey also assisted in conducting the spring 1968 measurements of depth-to-water.

## Previous Investigations

Stearns and others prepared reports on the ground-water resource of the Mud Lake area in 1922, 1930, and 1939 (Bryan and Stearns, 1922, Stearns,

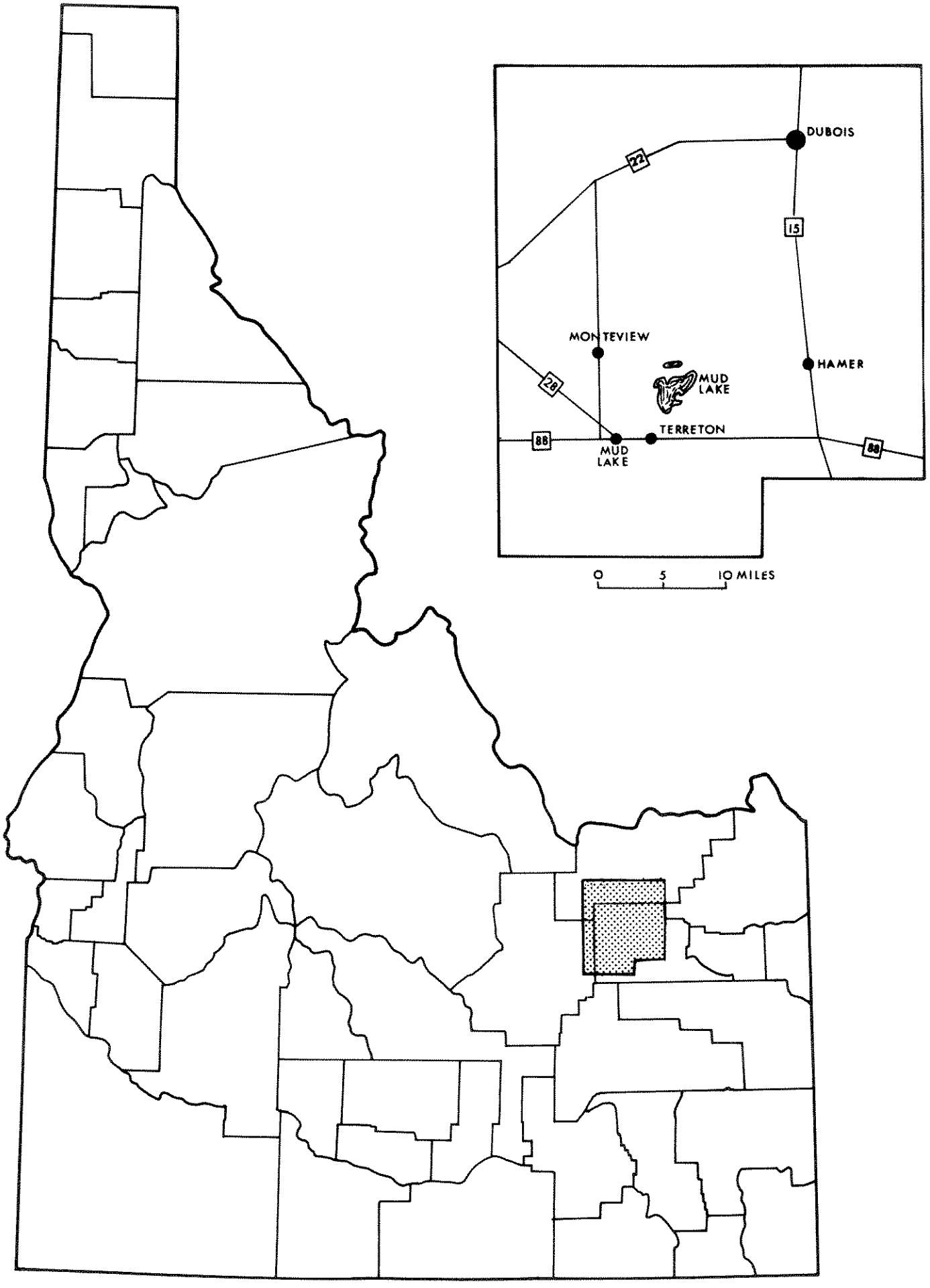


Figure 1.--Index map showing the area covered by this report

1930, and Stearns, Bryan and Crandell, 1939). Additional data was collected by Stevens (U. S. Geological Survey) during the period 1957-61. The 1957, 1958 and 1959 water level measurements that are presented later in the report were obtained as a part of the Stevens study. The discussion of ground-water geology included in this report was abstracted from the 1939 study of the Mud Lake area (Stearns et al., 1939).

### History and Extent of Ground-Water Development

Well development in the Mud Lake area was initiated about the turn of the century when irrigation of farm lands began. Many flowing and non-flowing wells were drilled during the 1920's. A well inventory conducted in 1929 indicated over 300 wells were being used in the area (Stearns et al., 1939, p. 5). The well development has continued to the present. This development is graphically depicted in figure 2 by increasing power demand by pumps for the period 1946-67. The estimated present ground-water discharge in the Mud Lake area is in excess of 200,000 acre-feet per year (Ralston, 1968, p. 4).

## GROUND-WATER GEOLOGY

The Mud Lake plain is bounded on the north by the Beaverhead and Centennial Mountains, on the east by the Big Bend Ridge, on the west by the Lemhi and Lost River Ranges, and merges with the Snake Plain on the south. The area consists of an undulating lava plain and a broad, flat expanse of lake sediments. Cinder cones and lava buttes rise above the plain and are the prominent topographic features.

### Pre-Tertiary Rocks

Rocks of Mesozoic and Paleozoic age crop out in the mountains adjacent to the Mud Lake plain. Limestone, shale, sandstone, and conglomerate of Carboniferous and Cretaceous age are present in the Beaverhead and

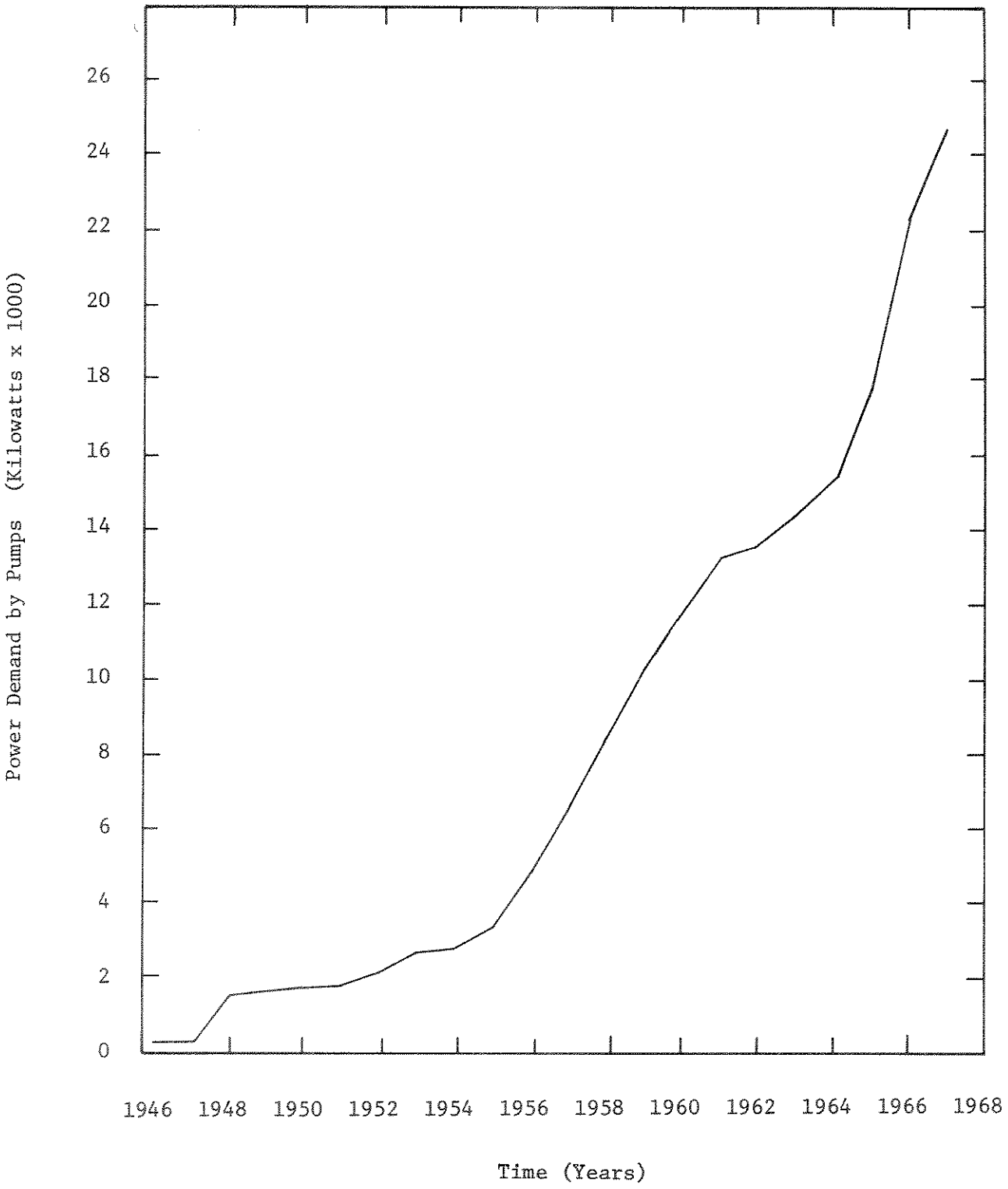


Figure 2.--Well development shown by increasing power demand by pumps, 1946-67

Centennial Mountains. These ancient rocks are so highly cemented and deformed that they are nearly impermeable. Any ground water present would probably be limited in both quantity and areal extent.

### Tertiary Rocks

Rhyolite and associated volcanic rocks of late Tertiary age outcrop along the mountain front to the north and east of the Mud Lake plain. These rocks are generally light colored, fragmental rhyolite and welded ash flows. Basalt overlies the rhyolite at several locations. The total thickness of the Tertiary volcanic rocks is unknown but probably exceeds 2000 feet. Most of the wells that have been drilled into the rhyolite in the Mud Lake area have low yields.

Sedimentary rocks of Pliocene (?) age overlie the older Tertiary volcanic rocks along the mountain front. These deposits have an exposed thickness of approximately 500 feet and are remnants of ancient alluvial fans.

### Quaternary Rocks

The Mud Lake plain is underlain by large volumes of volcanic rocks. These rocks are predominantly basalt with a few flows of andesite. The sources of these rocks were innumerable volcanic cones and fissures. Remnants of some of these vents now form small hills on the plain. Differences in erosion of various craters and numerous sedimentary interbeds indicate the eruption of lava took place intermittently over a long period of time. The basalts, extruded as thin, low viscosity flows, are highly jointed and have cavernous, slaggy contacts. These features, in combination with lava tubes and blisters, provide openings for ground-water flow beneath the Mud Lake plain. Ground water moves almost unimpeded through these rocks and yields to wells of 4500 gpm (gallons per minute) with little drawdown are common.

Lake beds consisting of sand, clay, and silt are present near Mud Lake. These sediments were deposited in a shallow lake formed when ancient creeks to the north discharged into a structural depression. The lake covered approximately 140 square miles at its highest stage. Numerous angular lava boulders, present in the lake sediments, were presumably rafted from shore by ice during the winter months. The lake sediments, which interfinger with the younger basalt flows, act more as confining beds than aquifers. A high water table, present near Mud Lake, is a result of the low permeability of these sediments. Extensive deltas were formed where the creeks flowed into the ancient lake. These deposits, consisting primarily of sand and gravel, are located along the northern edge of the lake beds. Some of these delta sediments have been penetrated by wells in the Monteview and Camas areas and yield small quantities of water.

Alluvium of both Pleistocene and Holocene age is present along the major stream valleys and along the hill front as broad coalescing fans. These fans generally consist of detritus from the older sedimentary rocks exposed in the mountains.

## Structure

The Mud Lake plain is bounded to the east, north, and northwest by highly deformed Paleozoic and Mesozoic rocks. These rocks may be considered as ground-water barriers because of their low permeability. The Mud Lake plain is open to the south and west, which indicates that any ground-water flow out of the basin would probably be in this direction. The Tertiary rhyolites have been flexed into a large structural depression while the basalts of Quaternary age have undergone only local, minor deformation. The movement of ground water in the Mud Lake area is not believed to be controlled by structural features.

## ANALYSIS OF DATA

The data used in evaluating water level changes in the Mud Lake area are presented in table 1. The depth-to-water was measured in 229 wells in the spring of 1968. One hundred and thirty-five of these wells were measured in 1958, 28 either in 1957 or 1959, and 66 were not previously measured. The locations of the wells measured are shown in figure 3.

### Depth-to-Water

Ground-water levels are within 100 feet of land surface beneath most of the Mud Lake area. The depth-to-water is greater than 200 feet in the extreme northern, western and southern portions of the study area. The deepest water levels are present in the extreme northern portion of the area where depths-to-water exceed 400 feet.

The state engineer has been charged by statute with the responsibility of determining the reasonable pumping level in each ground-water area in the state. Although several studies have been initiated, a reasonable pumping level for the Mud Lake area has not yet been determined. The partial results that have been obtained, however, indicate that the 100-foot depth-to-water common to the Mud Lake area is above the reasonable pumping level.

### Ground-Water Flow

Contours of water level elevation using the pring 1968 data are presented in figure 3. The contours indicate that the general movement of ground water is from the northeast to the southwest. The gradient or slope of the ground-water surface is very flat (1 to 2 feet per mile) from the vicinity of Dubois to the vicinity of Monteview and Mud Lake. The water levels in this area are believed to represent either a perched ground-water system or a dammed or constricted ground-water system. The contours of water level elevation from 4520 to 4600 feet (mean sea level datum) in the

southern and western portions of the study area are believed to represent the deeper, more general ground-water system underlying the Snake Plain. The gradient in this area is approximately 10 feet per mile. The water levels in a number of wells do not conform to either the upper level or the more general lower system. These water levels range from 4700 to 4760 feet in elevation, above the highest level in the lower system and 20 feet below the lowest level in the perched zone. This intermediate zone might be either a single or series of lower perched zones, or simply the downward flow of water over the edges of the interbedded sediments.

## Water-Level Changes

The 1958-68 water-level changes for 135 wells in the Mud Lake area are presented in figure 4. Water-level changes for the periods 1957-68 and 1959-68 are presented for 28 additional wells. The data do not indicate any general change in water levels in the 10-year period. Eighty-six percent of the wells had changes between plus or minus 5 feet. Only 6 percent of the wells indicated a water-level change of 10 feet or greater during the 10-year period.

The water-level changes that have occurred may be related to the contour map of water-level elevation presented in figure 3. Only minor water-level changes occurred in the upper zone north and east of Mud Lake and Monteview. Small rises and declines were noted in the general ground-water system in the southern and western portions of the study area. Most of the larger changes occurred in wells that have 1968 water-level elevation ranging from 4700 to 4760 feet, the intermediate zone shown on figure 4. In order to evaluate the water-level fluctuations in this zone, the location, depth, and water-surface elevation of the wells with changes greater than 5 feet are presented in figure 5. The largest areas of water-level change

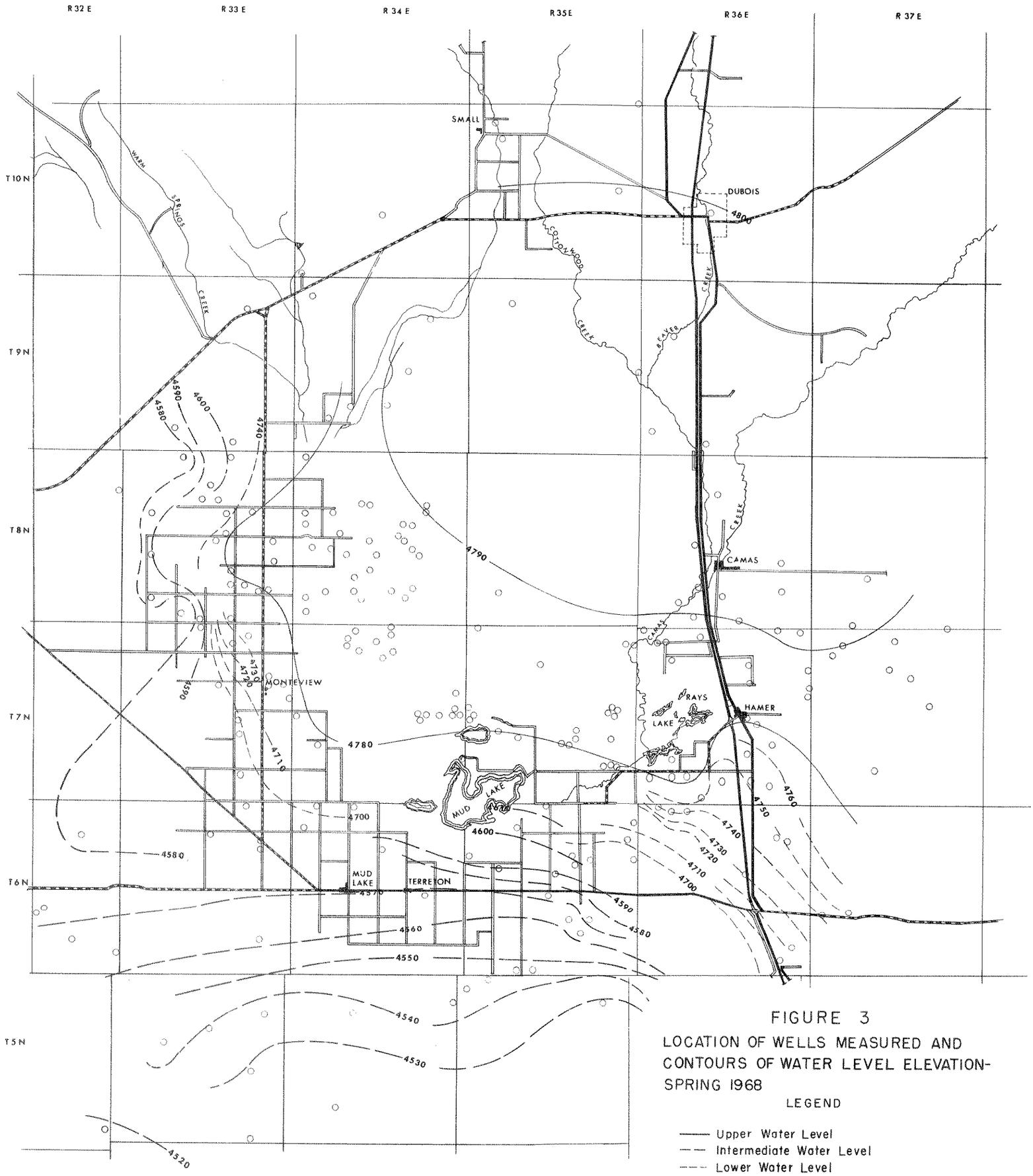


FIGURE 3

LOCATION OF WELLS MEASURED AND CONTOURS OF WATER LEVEL ELEVATION- SPRING 1968

LEGEND

—— Upper Water Level
– – Intermediate Water Level
– – – Lower Water Level

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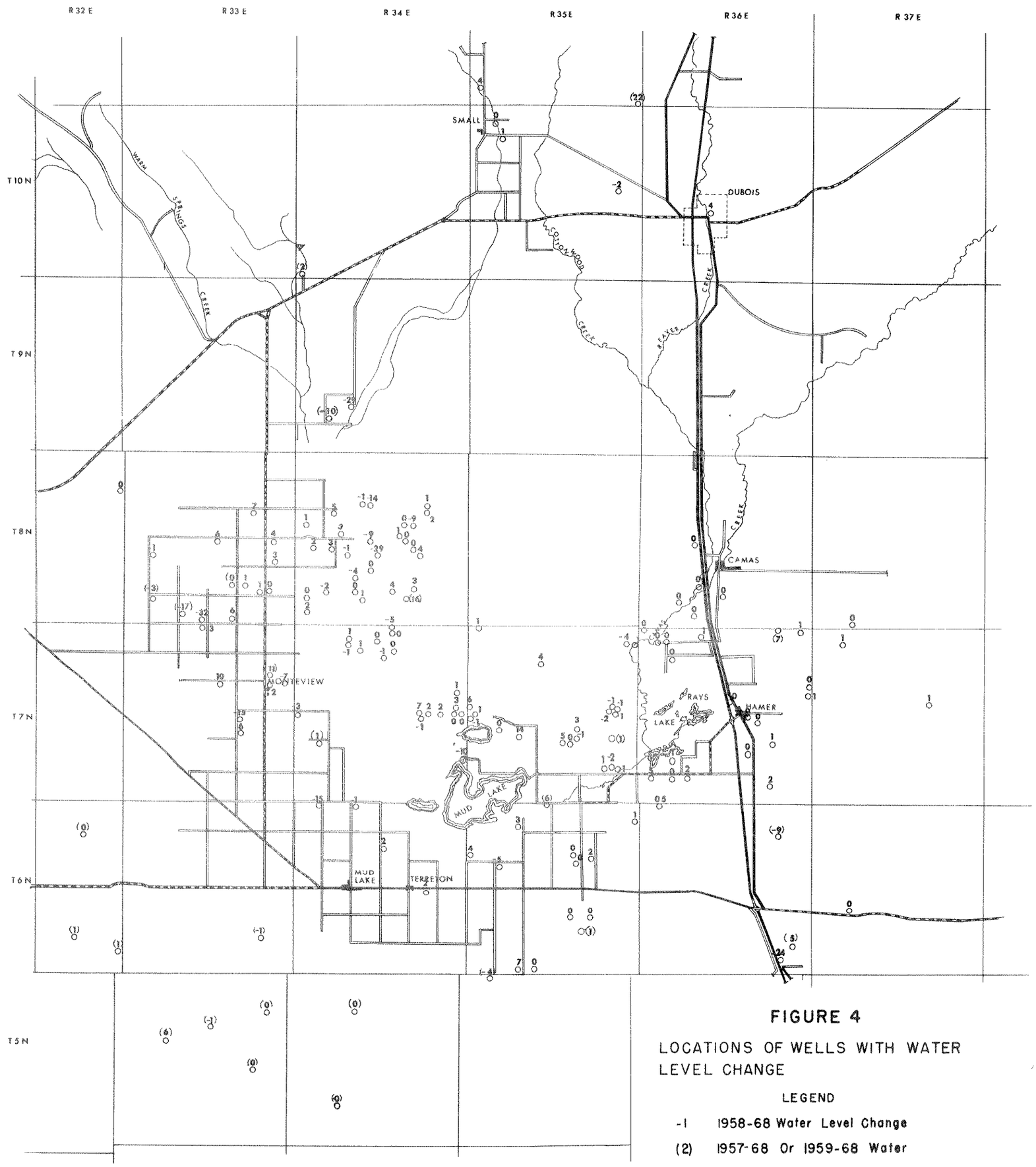


# FIGURE 4

LOCATIONS OF WELLS WITH WATER LEVEL CHANGE

LEGEND

-1 1958-68 Water Level Change

(2) 1957-68 Or 1959-68 Water Level Change

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# FIGURE 5

## WELLS WITH LARGE WATER LEVEL CHANGE

LEGEND

| | |
|---|---|
| -15 | Water Level Change |
| 230 | Depth of Well |
| 696 | Elevation of Water Surface in Well (+4000') |

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are along the western and southern edges of the upper zone. Declines from 5 to 29 feet have occurred in T. 7-8 N., R. 34 E. at water level elevations from 4756 to 4780 feet. Rises of 5 to 15 feet are shown in T. 7 N., R. 34-36 E. at approximately the same elevation. Other water-level changes are shown on figure 5 to the west and south of the areas described above. These declines vary with the depth and location of the well, and the depth-to-water.

The large changes in water-level elevation are believed to occur in aquifers limited in vertical extent by sedimentary strata. These strata impede the downward flow of water from the upper zone and form small perched zones at lower elevations. The water levels in these small perched zones are subject to large fluctuations as a result of changes in recharge. The sedimentary strata become more discontinuous to the south and west allowing water to move downward to the general aquifer system.

## SUMMARY AND CONCLUSIONS

Water levels beneath most of the Mud Lake area are within 100 feet of land surface. The depth-to-water is greater than 200 feet in the extreme northern, western, and southern portions of the study area. The depth-to-water of 100 feet or less, common to most of the Mud Lake area, is above the preliminary estimate of the reasonable pumping level.

Contours of water-level elevation in the Mud Lake area based on the spring 1968 measurements indicate flow from the northeast to the southwest. Upper, intermediate, and lower zones are delineated by the contours. The upper and lower zones have gradients of approximately 2 and 10 feet per mile respectively, while the intermediate zone has a steeper gradient of 20 feet per mile.

The water-level change data indicate that the ground-water levels in the Mud Lake area have not changed significantly during the period 1958-68. Eighty-six percent of the wells measured did not experience water-level changes of plus or minus 5 feet in the 10-year period. Most of the wells with changes of 5 feet or more draw water from an intermediate zone between the upper zone at Mud Lake and the deeper more general aquifer system. The changes do not represent a significant portion of the ground-water resource of the Mud Lake area.

The present well development has not significantly altered the ground-water resource in the Mud Lake area. Additional well development can occur without causing widespread declines in water levels. Specific areas near Mud Lake may, however, show local declines and rises as the recharge varies in magnitude and location.

TABLE 1

HYDROLOGIC DATA

| Well Location Number | Year Drilled | Depth of Well (feet) | Diameter of Casing (inches) | Elev. L.S.D. (feet) | 1968 Elev. W.S. (feet) | 58-68 10-year W.L. Change (feet) |
|---|---|---|---|---|---|---|
| 5N 32E 36 ad 1 | 1952 | 405 | 6 | 4839.4 | 4511.0 | |
| 5N 33E 10 cd 1 | 1953 | 428 | 8 | 4786.2 | 4533.3 | -1(a) |
| 13 bd 1 | 1953 | 405 | 8 | 4794.6 | 4529.9 | 0(a) |
| 17 ad 1 | 1953 | 334 | 6 | 4771.6 | 4543.7 | 6(a) |
| 23 dd 1 | 1953 | | 6 | 4812.4 | 4527.6 | 0(a) |
| 5N 34E 1 dd 1 | 1967 | 410 | 20 | 4788 | 4541 | |
| 9 bd 1 | 1950 | 553 | 6 | 4791.3 | 4535.1 | 0(a) |
| 29 da 1 | 1953 | 425 | 6 | 4877.5 | 4528.1 | 0(a) |
| 5N 35E 1 cc 1 | 1959 | 300 | 24 | 4759 | 4524 | |
| 5 bb 1 | 1959 | 300 | 6 | 4790 | 4543 | -4(b) |
| 6 bd 1 | 1956 | 301 | 16 | 4790 | 4542 | |
| 6N 32E 11 ab 1 | 1952 | 266 | 6 | 4789.8 | 4582.0 | 0(a) |
| 26 cd 1 | 1956 | 322 | 8 | 4787.9 | 4567.7 | 1(a) |
| 36 ad 1 | 1949 | 292 | 8 | 4785.6 | 4563.7 | 1(a) |
| 6N 33E 10 db 1 | 1965 | 630 | 20 | 4784(e) | 4681(e) | |
| 11 ad 1 | 1967 | 351 | 16 | 4785(e) | 4669(e) | |
| 11 da 1 | 1960 | 332 | 12 | 4785 | 4660 | |
| 26 dd 1 | 1952 | 312 | 6 | 4784.3 | 4561.4 | -1(a) |
| 6N 34E 4 bb 1 | | 27 | 36 | 4782.9 | 4765 | -1 |
| 6 aa 1 | 1957 | 400 | 18 | 4783.3 | 4703.1 | -15 |
| 6 cd 1 | 1962 | 192 | 12 | 4785 | 4632 | |
| 10 cb 1 | | 12 | 15 | 4781.3 | 4774.1 | 2 |

TABLE 1

HYDROLOGIC DATA (Cont'd.)

| Well Location Number | Year Drilled | Depth of Well (feet) | Diameter of Casing (inches) | Elev. L.S.D. (feet) | 1968 Elev. W.S. (feet) | 58-68 10-year W.L. Change (feet) |
|---|---|---|---|---|---|---|
| 6N 34E 22 ba 1 | 1944 | 262 | 6 | 4786 | 4683 | |
| 22 ab 2 | 1938 | 267 | 6 | 4786.6 | 4648.8 | |
| 23 ab 1 | | 270 | 6 | 4785.6 | 4567.8 | 2 |
| 6N 35E 1 da 1 | 1954 | 375 | 18 | 4793.7 | 4711.1 | 1 |
| 4 aa 1 | 1929 | 185 | 6 | 4785 | 4614 | 6(b) |
| 5 dd 1 | 1950 | 204 | 6 | 4783 | 4602 | 3 |
| 7 cc 1 | 1929 | 253 | 6 | 4782.5 | 4586.9 | 4 |
| 10 ca 1 | 1951 | 130 | 6 | 4782.9 | 4694.8 | 0 |
| 11 cd 1 | | 120 | 6 | 4787.5 | 4694.8 | 2 |
| 12 ab 1 | 1966 | 152 | 16 | 4785 | 4696 | |
| 12 dd 1 | 1967 | 196 | 8 | 4784 | 4639 | |
| 12 bc 1 | 1965 | 150 | 18 | 4786 | 4694 | |
| 15 aa 1 | 1947 | 132 | 6 | 4787.5 | 4695.4 | 0 |
| 15 bc 1 | 1966 | 137 | 6 | 4786 | 4696 | |
| 17 bb 1 | 1954 | 215 | 6 | 4783.8 | 4591.4 | -5 |
| 26 ba 1 | 1957 | 307 | 21 | 4790.6 | 4574.7 | 0 |
| 27 ab 1 | 1957 | 350 | 20 | 4796 | 4559 | 0 |
| 27 dda 1 | | 260 | 20 | 4798.7 | 4564.9 | 1(a) |
| 32 dd 1 | 1955 | 292 | 6 | 4789.2 | 4546.7 | 7 |
| 33 cd 1 | 1956 | 400 | 16 | 4792.3 | 4547.9 | 0 |
| 6N 36E 5 adb 1 | 1959 | 190 | 16 | 4857.4 | 4724.4 | |
| 5 bdb 1 | | 188 | 20 | 4841 | 4743 | |

TABLE 1

HYDROLOGIC DATA (Cont'd.)

| Well Location Number | Year Drilled | Depth of Well (feet) | Diameter of Casing (inches) | Elev. L.S.D. (feet) | 1968 Elev. W.S. (feet) | 58-68 10-year W.L. Change (feet) |
|---|---|---|---|---|---|---|
| 6N 36E 6 ab 1 | 1956 | 130 | 16 | 4792.5 | 4720.5 | 0.5 |
| 11 aa 2 | 1957 | 165 | 18 | 4820 | 4743 | -9(b) |
| 12 bb 1 | | 62 | 6 | 4810 | 4754 | |
| 15 aca 1 | 1959 | 170 | 12 | 4875.3 | 4723.8 | |
| 27 baa 1 | 1960 | 227 | 8 | 4884.5 | 4700.6 | |
| 35 da 1 | | 39.2 | 48 | 4795 | 4753 | -24 |
| 36 ba 2 | | 64 | 6 | 4760 | 4722 | 5(a) |
| 6N 37E 19 cdc 1 | | | | 4769 | 4741 | |
| 20 cbd 1 | | 45 | 6 | 4810.3 | 4777.3 | 0 |
| 7N 33E 2 db 1 | 1957 | 335 | 21 | 4786.4 | 4730 | |
| 3 da 2 | 1949 | 26 | 6 | 4789.3 | 4763.1 | |
| 4 aa 1 | 1952 | 236 | 18 | 4790(e) | 4710 | 3 |
| 11 dd 2 | 1950 | 36 | 6 | 4786.2 | 4752 | |
| 12 cc 1 | 1953 | 290 | 16 | 4790 | 4749 | 11(b) |
| 13 ab 1 | 1951 | 350 | 16 | 4789(e) | 4750 | -7 |
| 13 bb 1 | 1934 | 23.5 | 36 | 4789(e) | 4781 | 2 |
| 13 bb 3 | | | | 4789(e) | 4781 | |
| 13 dac 1 | 1965 | 285 | 20 | 4787(e) | 4750 | |
| 14 dd 1 | 1959 | 50 | 1.25 | 4787(e) | 4711 | |
| 15 ba 1 | 1959 | 200 | 6 | 4786(e) | 4690 | 10 |
| 16 ba 1 | 1955 | 335 | 16 | 4786 | 4647 | 79 |
| 23 bc 1 | 1953 | 230 | 6 | 4784(e) | 4696 | -15 |

TABLE 1

HYDROLOGIC DATA (Cont'd.)

| Well Location Number | Year Drilled | Depth of Well (feet) | Diameter of Casing (inches) | Elev. L.S.D. (feet) | 1968 Elev. W.S. (feet) | 58-68 10-year W.L. Change (feet) |
|---|---|---|---|---|---|---|
| 7N 33E 23 cc 2 | | 52.5 | 14 | 4783.9 | 4772.6 | 6 |
| 7N 34E 3 ba 1 | 1953 | 75 | 30 | 4797.7 | 4780.3 | -5 |
| 3 ba 2 | 1953 | 75 | 30 | 4799.1 | 4784.3 | 0 |
| 3 cd 1 | 1953 | 67 | 30 | 4797 | 4785 | |
| 4 bc 1 | | | | 4795 | 4786 | |
| 4 cdc 1 | 1953 | 57.3 | 6 | 4791.8 | 4784.6 | 1 |
| 4 da 1 | 1949 | 67 | 36 | 4792.4 | 4785.1 | 0 |
| 5 da 1 | | 25.1 | 30 | 4789.9 | 4785.9 | 1 |
| 5 da 2 | | 21.6 | 24 | 4789 | 4787 | -1 |
| 5 da 3 | 1955 | 46 | 6 | 4791 | 4784 | |
| 10 bb 2 | 1930 | 65 | 36 | 4791.2 | 4783.9 | -1 |
| 10 bc 4 | | 501 | | 4791.2 | 4783.9 | |
| 13 ac 1 | 1951 | 51 | 24 | 4799.6 | 4783.7 | 1 |
| 13 dc 1 | 1951 | 126 | 24 | 4791.8 | 4784.8 | 3 |
| 19 bb 1 | | 72 | 6 | 4783.8 | 4779.6 | -3 |
| 23 aa 1 | | 77 | | 4793.1 | 4783.5 | 2 |
| 23 ba 2 | | 24.7 | 6 | 4791.8 | 4782.9 | -1 |
| 23 ba 3 | 1958 | 135 | 28 | 4791.8 | 4783.5 | 7 |
| 24 aa 1 | | 100 | 30 | 4791.6 | 4783.6 | 0 |
| 24 ab 1 | 1951 | 91 | 26 | 4791.6 | 4783.7 | 0 |
| 24 bb 1 | | 74 | | 4793.4 | 4783.3 | 2 |
| 25 da 1 | 1943 | 410 | 4 | 4793.1 | 4759.5 | -10 |

TABLE 1

HYDROLOGIC DATA (Cont'd.)

| Well Location Number | Year Drilled | Depth of Well (feet) | Diameter of Casing (inches) | Elev. L.S.D. (feet) | 1968 Elev. W.S. (feet) | 58-68 10-year W.L. Change (feet) |
|---|---|---|---|---|---|---|
| 7N 34E 30 aa 1 | | 141 | 40 | 4781.8 | 4779.4 | 1(b) |
| 7N 35E 1 da 1 | 1956 | 174 | 18 | 4793.9 | 4784.2 | -4 |
| 1 db 1 | 1957 | 203 | 24 | 4799.7 | 4790.0 | 1 |
| 6 ba 1 | | | 6 | 4849 | 4777 | 1 |
| 9 ad 1 | | | 5 | 4867 | 4786 | 4 |
| 13 cc 1 | 1934 | 30 | 24 | 4792.3 | 4782.1 | -2 |
| 13 cc 2 | 1934 | 112 | 30 | 4790.6 | 4782.0 | -1 |
| 13 cc 4 | 1957 | 19 | | 4793.7 | 4785.2 | 1 |
| 13 cc 5 | 1959 | 36 | 24 | 4794.3 | 4784.1 | -1(b) |
| 18 cc 1 | 1957 | 132 | 28 | 4796.9 | 4773.7 | 6 |
| 19 ba 1 | 1957 | 105 | 24 | 4803.3 | 4783.5 | 1 |
| 19 bc 3 | 1957 | 160 | 26 | 4790.2 | 4784 | -1 |
| 20 cbd 1 | 1953 | 58 | 20 | 4818.2 | 4782.8 | 0 |
| 20 dd 1 | 1954 | 99 | 24 | 4798.8 | 4780.3 | 14(b) |
| 22 da 2 | 1954 | 36 | | 4791.4 | 4785.6 | 3 |
| 22 dd 1 | 1952 | 45 | 30 | 4792.5 | 4782.2 | -1 |
| 25 bb 1 | 1954 | 83 | 26 | 4788.3 | 4781.7 | 1 |
| 25 cc 1 | 1945 | 65 | 18 | 4792 | 4779 | -2 |
| 25 cc 2 | 1939 | 65 | 24 | 4794.4 | 4776.0 | 1 |
| 26 dd 2 | 1945 | 65 | 24 | 4792 | 4783 | 1 |
| 27 ab 1 | 1934 | 30 | 24 | 4788.5 | 4781.7 | 0 |
| 27 ba 1 | 1930 | 30 | 20 | 4789.7 | 4783.5 | 5(b) |

TABLE 1

HYDROLOGIC DATA (Cont'd.)

| Well Location Number | Year Drilled | Depth of Well (feet) | Diameter of Casing (inches) | Elev. L.S.D. (feet) | 1968 Elev. W.S. (feet) | 58-68 10-year W.L. Change (feet) |
|---|---|---|---|---|---|---|
| 7N 36E 1 ad 1 | | | 8 | 4933.3 | 4789.3 | 1 |
| 2 aa 1 | 1956 | 231 | 20 | 4831 | 4592 | 7(b) |
| 4 bc 1 | 1945 | 80 | 12 | 4805.8 | 4789.6 | 1 |
| 6 bb 1 | 1954 | 40 | 14 | 4798.2 | 4789.3 | 0 |
| 6 da 1 | 1933 | 151 | 10 | 4797.2 | 4788.2 | 0 |
| 6 db 2 | 1957 | 165 | 24 | 4795.1 | 4789.4 | 0 |
| 8 bb 1 | | 200 | | 4800.3 | 4788.3 | 0 |
| 10 aab 1 | 1961 | 168 | 20 | 4885 | 4787 | |
| 10 dd 1 | 1954 | 65 | 6 | 4812 | 4782 | |
| 12 adc 1 | 1966 | 225 | 20 | 4903 | 4793 | |
| 13 aa 1 | 1956 | 153 | 16 | 4851.9 | 4787.4 | 1 |
| 13 ad 1 | 1947 | 101 | 10 | 4829.4 | 4787.5 | 1 |
| 15 cb 1 | 1947 | 120 | 10 | 4794.4 | 4787.0 | 0 |
| 22 abd 4 | | 35 | 6 | 4791.7 | 4785.3 | 0 |
| 23 bc 1 | 1935 | 130 | 12 | 4807.3 | 4786.4 | 0 |
| 26 ab 2 | 1952 | 58 | 6 | 4797.5 | 4767.1 | 1 |
| 27 ad 1 | | 50 | 6 | 4800 | 4759 | 0 |
| 29 dbb 1 | 1952 | 375 | 24 | 4790.4 | 4782.8 | 1 |
| 31 bab 1 | 1946 | 100 | 12 | 4785.4 | 4759.7 | 5 |
| 32 ab 1 | 1948 | 275 | 12 | 4791.6 | 4783.8 | 2 |
| 32 bb 1 | 1953 | 438 | 14 | 4790.8 | 4781.4 | 0 |
| 33 aaa 1 | 1967 | 100 | 6 | 4805 | 4748 | |

TABLE 1

HYDROLOGIC DATA (Cont'd.)

| Well Location Number | Year Drilled | Depth of Well (feet) | Diameter of Casing (inches) | Elev. L.S.D. (feet) | 1968 Elev. W.S. (feet) | 58-68 10-year W.L. Change (feet) |
|---|---|---|---|---|---|---|
| 7N 36E 33 cb 1 | 1951 | 367 | 13 | 4808.0 | 4782.7 | |
| 34 aa 1 | 1966 | 150 | 16 | 4820 | 4746 | |
| 35 acc 1 | | 100 | 20 | 4816 | 4754 | 2 |
| 7N 37E 4 adc 1 | 1964 | 135 | 20 | 4858 | 4787 | |
| 5 cbc 1 | | 135 | 6 | 4908.4 | 4789.1 | 1 |
| 6 dcc 1 | 1963 | 205 | 20 | 4919 | 4791 | |
| 9 acb 1 | 1964 | 115 | 20 | 4855 | 4791 | |
| 10 cad 1 | 1967 | 242 | 20 | 4848 | 4789 | |
| 14 cbc 1 | 1922 | 93.3 | 6 | 4863.8 | 4787.7 | 1 |
| 28 ccd 1 | 1960 | 135 | 8 | 4848.5 | 4784.6 | |
| 8N 32E 12 ad 1 | 1957 | 335 | 20.75 | 4980(e) | 4717 | 0 |
| 8N 33E 1 ba 1 | 1964 | 214 | 20 | 4810(e) | 4748 | |
| 3 aa 1 | 1962 | 385 | 20 | 4809(e) | 4607 | |
| 4 bb 1 | 1964 | 400 | 20 | 4812(e) | 4549 | |
| 9 da 2 | | | 8 | 4809(e) | 4715 | |
| 10 bb 1 | 1963 | 338 | 20 | 4810(e) | 4689 | |
| 10 ca 1 | 1966 | 200 | 16 | 4809(e) | 4737 | |
| 14 ab 1 | 1953 | 245 | 18 | 4806.6 | 4754.4 | 7 |
| 15 ab 1 | 1959 | 220 | 20 | 4807 | 4733 | |
| 15 dc 1 | 1960 | 200 | 20 | 4805 | 4745 | |
| 17 bb 1 | 1963 | 400 | 20 | 4815(e) | 4587 | |
| 20 cb 1 | 1958 | 350 | 20 | 4875 | 4644 | -1 |

TABLE 1

HYDROLOGIC DATA (Cont'd.)

| Well Location Number | Year Drilled | Depth of Well (feet) | Diameter of Casing (inches) | Elev. L.S.D. (feet) | 1968 Elev. W.S. (feet) | 58-68 10-year W.L. Change (feet) |
|---|---|---|---|---|---|---|
| 8N 33E 22 ba 1 | 1956 | 260 | 20 | 4811 | 4745 | 6 |
| 24 ba 1 | 1955 | 54 | 18 | 4797 | 4786 | 4 |
| 24 cd 2 | | | 18 | 4795.4 | 4783.9 | 3 |
| 25 cc 1 | 1914 | 16 | | 4792 | 4780 | 0 |
| 26 ca 2 | 1955 | 68 | 20 | 4800 | 4785 | 1 |
| 26 dd 3 | 1947 | 28 | 6 | 4803 | 4791 | 1 |
| 27 aa 1 | 1957 | 350 | 20 | 4812 | 4789 | |
| 27 da 1 | 1952 | 35 | 30 | 4812 | 4792 | 0(b) |
| 32 bb 1 | 1959 | 300 | 20 | 4803 | 4581 | -3(b) |
| 33 cb 1 | 1958 | 250 | 18 | 4750 | 4567 | -17(b) |
| 33 dd 1 | 1954 | 145 | 6 | 4793 | 4676 | -32 |
| 34 cd 1 | 1951 | 170 | 6 | 4794 | 4729 | 6 |
| 8N 34E 9 dc 1 | 1954 | 104 | 18 | 4824 | 4773 | -14 |
| 9 dc 2 | 1956 | 114 | 30 | 4821.7 | 4787.5 | -1 |
| 11 dc 1 | 1955 | 116 | 24 | 4870.5 | 4788.0 | -1 |
| 11 dd 1 | 1955 | 129 | 24 | 4875.7 | 4790.1 | 2 |
| 14 ab 2 | 1957 | 118 | 30 | 4865.6 | 4789.1 | 0 |
| 14 cb 1 | 1955 | 78 | 34 | 4826.8 | 4778.6 | -9 |
| 15 da 1 | | 68 | 24 | 4826.1 | 4788.3 | 0 |
| 15 dca 1 | 1954 | 83 | 24 | 4822.4 | 4787.8 | 1 |
| 17 dc 2 | 1927 | 97 | 10 | 4802.1 | 4788.4 | 3 |
| 18 ba 4 | 1954 | 65 | 18 | 4803.7 | 4789.9 | 5 |

TABLE 1

HYDROLOGIC DATA (Cont'd.)

| Well Location Number | Year Drilled | Depth of Well (feet) | Diameter of Casing (inches) | Elev. L.S.D. (feet) | 1968 Elev. W.S. (feet) | 58-68 10-year W.L. Change (feet) |
|---|---|---|---|---|---|---|
| 8N 34E 18 ca 1 | 1947 | 40 | 16 | 4811 | 4786 | 1 |
| 19 ac 1 | 1953 | 55 | 16 | 4817.1 | 4785.6 | 2 |
| 20 bd 2 | 1950 | 310 | 20 | 4813 | 4785 | 3 |
| 20 da 1 | 1946 | 46 | 22 | 4812.4 | 4785.4 | -1 |
| 21 ab 1 | 1956 | 73 | 26 | 4825.1 | 4776.6 | -9 |
| 21 da 1 | | 50 | 24 | 4804.2 | 4756.4 | -29 |
| 22 aa 1 | 1953 | 81 | 30 | 4824.7 | 4786.9 | 0 |
| 23 bc 2 | 1953 | 87 | 24 | 4826.2 | 4787.4 | 0 |
| 23 ca 1 | | 95 | | 4830 | 4788 | 4 |
| 26 cc 1 | 1955 | 75 | 24 | 4813.9 | 4789.0 | 3 |
| 27 cd 1 | 1955 | 76 | 24 | 4815 | 4790 | 4 |
| 27 dd 1 | 1954 | 73 | 24 | 4809.4 | 4785.6 | 0 |
| 28 ab 1 | 1953 | 50 | 31 | 4803.9 | 4784.2 | 0 |
| 28 bc 1 | 1946 | 34.6 | 20 | 4800.1 | 4781.4 | -4 |
| 28 cc 1 | 1954 | 50 | 12 | 4803.7 | 4786.2 | 0 |
| 29 cc 1 | 1938 | 30.3 | 24 | 4796.8 | 4782.0 | -2 |
| 31 ba 3 | 1947 | 30 | 18 | 4795 | 4784 | 0 |
| 31 ca 1 | 1943 | 30.8 | 24 | 4793.9 | 4785.1 | 2 |
| 33 ba 1 | 1954 | 48 | 30 | 4793.7 | 4675.8 | 1 |
| 34 aa 1 | 1959 | 74 | 24 | 4820 | 4797 | 16(b) |
| 8N 35E 29 cc 1 | 1955 | 365 | 6 | 4979 | 4787 | |
| 8N 36E 9 acc 1 | 1914 | 67 | 6 | 4842 | 4794 | |

TABLE 1

HYDROLOGIC DATA (Cont'd.)

| Well Location Number | Year Drilled | Depth of Well (feet) | Diameter of Casing (inches) | Elev. L.S.D. (feet) | 1968 Elev. W.S. (feet) | 58-68 10-year W.L. Change (feet) |
|---|---|---|---|---|---|---|
| 8N 36E 21 bb 1 | | 45 | 6 | 4819.3 | 4789.7 | 0 |
| 23 ad 1 | 1967 | 176 | 20 | 4820 | 4795 | |
| 26 da 1 | 1967 | 145 | 20 | 4808 | 4747 | |
| 28 cb 1 | 1954 | 209 | 18 | 4812.9 | 4794.1 | 0 |
| 28 dd 2 | 1950 | 148 | 14 | 4812.2 | 4790.4 | 0 |
| 32 ba 1 | 1957 | 255 | 24 | 4800.4 | 4789 | 0 |
| 32 da 1 | | 101 | 12 | 4803 | 4789 | 0 |
| 34 ca 1 | | 158 | 20 | 4821 | 4785 | |
| 8N 37E 29 aad 1 | 1960 | 215 | 18 | 4922 | 4792 | |
| 32 cd 1 | | 123 | 6 | 4895.5 | 5789.5 | 0 |
| 8N 37E 35 dc 1 | | 160 | 4 | 4940 | 4792 | |
| 9N 33E 11 ba 1 | 1959 | 280 | 8 | 5000(e) | 4920 | |
| 32 aa 1 | | 435 | 20 | 4910(e) | 4586 | |
| 34 ad 1 | | | | 4885(e) | 4677 | |
| 9N 34E 22 aa 1 | | 118 | 24 | 4875 | 4792 | |
| 27 bd 1 | 1962 | 450 | 24 | 4860 | 4795 | |
| 29 ad 1 | 1952 | 420 | 20 | 4839 | 4777 | -29 |
| 29 cc 1 | | 200 | 6 | 4829 | 4769 | -10(b) |
| 9N 35E 5 cd 1 | 1964 | | | 4977 | 4789 | |
| 24 aa 1 | 1946 | 207 | 6 | 4924 | 4793 | |
| 9N 36E 8 cc 1 | | 290 | 6 | 4971 | 4792 | |
| 31 bad 1 | | | | 4920 | 4796 | |

TABLE 1

HYDROLOGIC DATA (Cont'd.)

| Well Location Number | Year Drilled | Depth of Well (feet) | Diameter of Casing (inches) | Elev. L.S.D. (feet) | 1968 Elev. W.S. (feet) | 58-68 10-year W.L. Change (feet) |
|---|---|---|---|---|---|---|
| 33 cbb 1 | 1962 | 155 | 12 | 4865 | 4787 | |
| 10N 34E 22 cc 1 | | 525 | | 5021 | 4756 | |
| 31 cc 1 | 1954 | 189 | 6 | 4916 | 4741 | 2(b) |
| 10N 35E 6 da 1 | 1944 | 229 | 6 | 5292 | 5128 | 0 |
| 8 bb 1 | 1949 | 360 | 8 | 5253.9 | 4998.7 | 1 |
| 13 cc 1 | | 370 | 6 | 5151 | 4794 | -2 |
| 10N 36E 21 ca 1 | 1903 | 615 | 10 | 5148.6 | 4791.5 | 4 |
| 11N 35E 15 cc 1 | 1960 | 254 | 6 | 5440 | 5223 | |
| 31 bd 1 | 1956 | 330 | 20 | 5362 | 5125 | 4 |
| 36 dd 1 | | 416 | 4 | 5307.6 | 4896.9 | 22(a) |

(a) 1957 Measurement

(b) 1959 Measurement

(e) Land Surface Elevation Estimated

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